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Abstract

IMPROVED ALUMINIUM ALLOYS AS FUEL CLADDING MATERIAL IN WATER COOLED POWER REACTORS

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Aluminium cladding material can reduce the fuel cost in a boiling heavy water reactor by 0.1 to 0.4 mills/kWh depending upon wall thickness, enrichment and other factors.

Extensive loop testing of aluminium alloys of nominal composition Al-10 $^{w}/_{o}$ Si, 1 $^{w}/_{o}$ Mg and 1 $^{w}/_{o}$ Ni at 265°C and 315°C has shown that the alloys have a general corrosion rate of 0.03 mm/year. This low rate makes these alloys readily applicable in water cooled power reactors. Creep tests at elevated temperatures show that the 10% Si, 1% Mg- alloys have appreciably better mechanical properties than 2 S or X8001. The creep strength is nevertheless not good enough to make the cladding-tube freestanding. The metal will consequently contract and expand according to the movement of the fuel. These strains may lead to fatigue failure and results from strain-fatigue tests are given. These show that the alloy will have a satisfactory life time.

The cladding tube may also fail because of ratcheting or similar phenomena and these problems are reviewed.

The assembly of fuel stringers with long non-free standing cladding tubes presents some difficulties and some experimental designs are shown. One of these is presently being tested at 315°C in an out-pile-loop. Elements of a similar design are being made for testing in the Halden Boiling Water Reactor in the very near future.